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Missouri's Forest Resources in 2000

Earl C. Leatherberry and Thomas B. Treiman

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1992 Folwell Avenue
Saint Paul, Minnesota 55108
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Missouri's Forest Resources in 2000

The North Central Research Station's Forest Inventory and Analysis (NCFIA) program began fieldwork for the fifth forest inventory of Missouri's forest in 1999. This inventory initiated the new annual inventory system in which one-fifth of the total field plots (considered one panel) in the State are measured each year. A complete inventory consists of measuring and compiling the data for all plots (or five panels). Once all panels have been measured, each will be remeasured approximately every 5 years. For example, in Missouri, the field plots measured in the 2000 panel will be remeasured in 2005.

In 2000, NCFIA continued the annual inventory effort with the second panel of the fifth forest inventory. This fifth inventory of Missouri's forest resources will be completed in 2003. However, because each year's sample is a systematic sample of the State's forests and because timely information is needed about Missouri's forest resources, estimates have been prepared from data gathered during the first 2 years of the inventory. Data presented in this report represent 40 percent of the field plots (or two panels) for a complete inventory and are a combination of the first year's panel from 1999 and the second year's panel from 2000. **Because of the limited number of field plots measured at this point, sampling errors are large and data in this report should be used with caution. Future estimates that incorporate data in this report are subject to change when ensuing annual inventories are completed and data compiled.** Results presented are estimates based on sampling techniques. As additional annual inventories are completed, the precision of the estimates will increase and additional data will be released.

Reports of previous inventories of Missouri are dated 1947, 1959, 1972, and 1989. Data from new inventories are often compared with data from earlier inventories to determine trends in forest resources. However, for the comparisons to be valid, the procedures used in the two inventories must be similar. As a result of our ongoing efforts to improve the efficiency and reliability of the inventory, several changes in procedures and definitions have been made since the last Missouri inventory in 1989 (Spencer *et al.* 1992) (See appendix). Some of these changes make it inappropriate to directly compare portions of the 2000 data with those published for 1989.

About the Authors:

Earl C. Leatherberry is a Resource Analyst with the North Central Research Station, St. Paul, MN.

Thomas B. Treiman is a Natural Resource Economist with the Missouri Department of Conservation, Columbia, MO.

RESULTS

Area

Missouri is located in the heart of the Central Hardwood region. Before large numbers of Euro-Americans settled the region, forests occupied an estimated 30 million acres or about 70 percent of the total land area of Missouri (King *et al.* 1949). Presently, Missouri's forest land area totals 15 million acres (table 1). To access recent trends in forest land area, timberland[1] area statistics from NCFIA inventories area are compared. Timberland area statistics are used as a surrogate for forest land because sampling errors were derived for each inventory's estimate of timberland area, and not forest land area. Tracking timberland is particularly useful for accessing trends in forest land in Missouri because timberland area accounts for approximately 97 percent of all forest land area in the State. During the 1970s, the area of timberland in Missouri declined to a historical low of 12.4 million acres (fig. 1). However, by 1989, timberland area had rebounded to 13.4 million acres. Between 1989 and 2000, Missouri's timberland area continued to increase to an estimated 14.6 million acres. The most recent increase should be viewed with the caveat that the latest estimate of timberland area is based on a partial inventory and therefore the 2000 estimate has a higher sampling error than prior inventories. Nonetheless, the 2000 estimate suggests that timberland area is at least holding steady, which is noteworthy considering that throughout Missouri suburban development continues to expand into rural lands.

Several factors are responsible for the recent trend of increasing timberland area in Missouri. Some of the increase results from a reclassification of wooded pasture to timberland. With livestock no longer grazing in many wooded pastures, additional trees became established and the land use classification changed from pasture to timberland. Also, the practice of clearing timberland for agriculture purposes slowed in some parts of Missouri, especially in the Ozarks. Further, trees naturally regenerated on former agriculture lands.

[1] *Timberland, a subset of forest land, is capable of growing trees at a minimum level (20 cubic feet per acre per year) and is not restricted from harvest.*

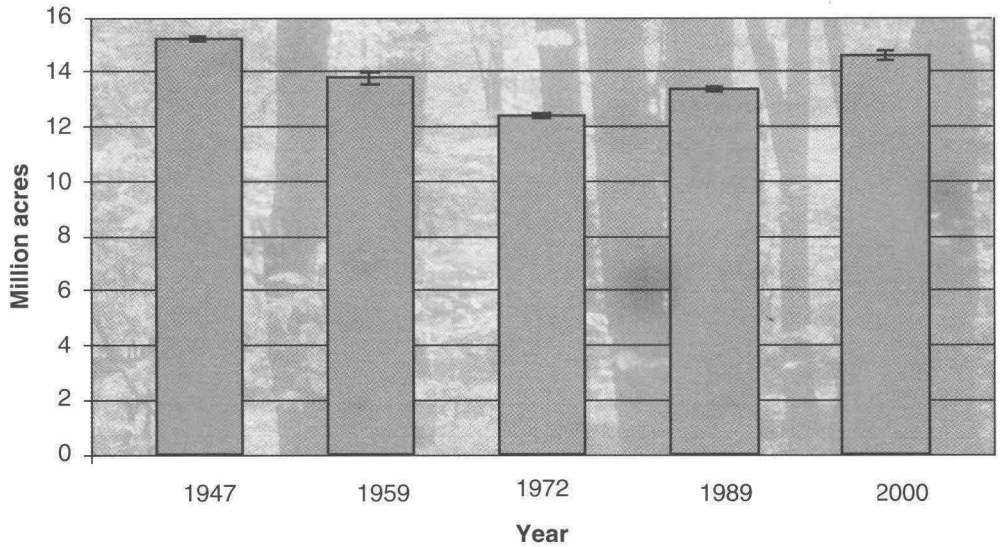

Figure 1. — Area of timberland, Missouri, 1947-2000. (Note: sampling errors associated with each inventory are represented by the vertical line at the top of each bar.)

There are an estimated 307,000 private owners of forest land in Missouri (Birch 1996). Those ownerships hold 82 percent (12.3 million acres) of the timberland in the State (table 1). Private forest landowners are a diverse group with differing motives or reasons for owning forest land. The level of forest management practiced on private forest lands is highly variable, ranging from no active management to highly integrated management. On the 18 percent of public forest land in Missouri, management objectives are in general clearly articulated and carried out over long periods of time.

Missourians, including those who are not forest landowners, have close associations with forests. Some work in the woods, while others work in wood-using industries that make Missouri one of the leading producers of wooden pallets, charcoal, oak barrels, and walnut products. Still other Missourians visit forests regularly to engage in recreational activities or to collect and gather nontimber products such as nuts.

The oak-hickory forest type occupies 10.7 million acres or 71 percent of Missouri's forest land area (table 1, fig. 2). When combined, hardwood types occupy 96 percent (14.4 million acres) of the forest land area, and conifer forest types occupy the remaining 4 percent of the State's forest land area. However, conifers make up a significant portion of some hardwood forest types because 7 percent (1.1 million acres) of the forest land area is classified as oak-pine forest type. Also, in recent years the eastern redcedar forest type has expanded in Missouri. Eastern redcedar is an early invader of abandoned pastures and agricultural fields, and the type accounts for nearly three-fourths of the area classed as softwood forest types. Eastern redcedar is likely to continue to expand in Missouri (Schmidt and Leatherberry 1995), and ensuing panels from the fifth Missouri inventory will provide more information about the magnitude of the expansion of eastern redcedar.

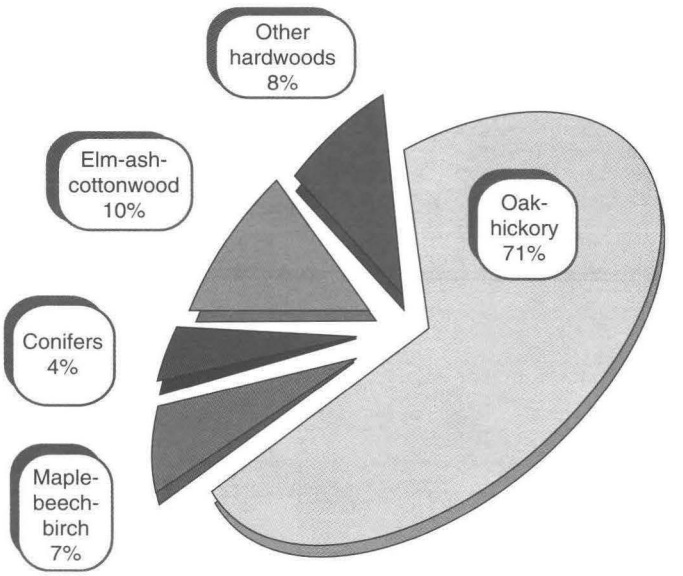

Figure 2. — *Area of forest land by forest type, Missouri, 2000.*

Missouri's timberland area is comprised primarily of natural stands (table 2). Many hardwood stands in the Ozark region of the State date from the 1930s, and many originated from hardwood sprouts (Kessler 1992). Before Euro-Americans settled the region, pines occupied an estimated 4 million acres in Missouri (Gansner 1965). Since the 1950s, pines have been reestablished through plantings, often on public lands. Presently, about 9 percent (51 thousand acres) of the area of softwood stands is in plantations, and about 84 percent (43 thousand acres) of the planted pine acres are on public timberlands. Stands in which shortleaf pine is a major component occupy 135 thousand acres. The majority of that acreage—64 percent—is publicly owned (table 3).

As Missouri's forests mature and are affected by natural and human-caused events, they take on certain stand-size characteristics. Stand-size class is a measure of the average diameter of the dominant trees in a stand. There are three stand-size classes: sawtimber—large trees, softwoods at least 9 inches in diameter at breast height (d.b.h.) and hardwoods at least 11 inches d.b.h.; poletimber—medium trees, trees 5 inches in d.b.h. to sawtimber size; and sapling/seedling—small trees, trees 1 to 5 inches in d.b.h. The structure of stands on timberland in Missouri has changed rather dramatically since the late 1940s (fig. 3). In 1947, only 12 percent of timberland area was in sawtimber-sized stands. But around then, increased fire suppression and improved forest management began to allow Missouri's forest stands to more fully develop. Through the ensuing years, the State's forests matured and sawtimber-sized stands expanded to cover almost half the area of timberland. Between 1989 and 2000, the area in sawtimber-size stands increased by over 600 thousand acres, but as a proportion of all timberland, it remained at about half the area. During the same period, the area of poletimber-size stands expanded and the area in seedling/sapling stands declined. In 2000, 49 percent of Missouri timberland area was in the sawtimber stand-size class, followed by 36 and 14 percent in poletimber and sapling-seedling stands, respectively (table 3). Less than 1 percent of the timberland area is currently nonstocked.

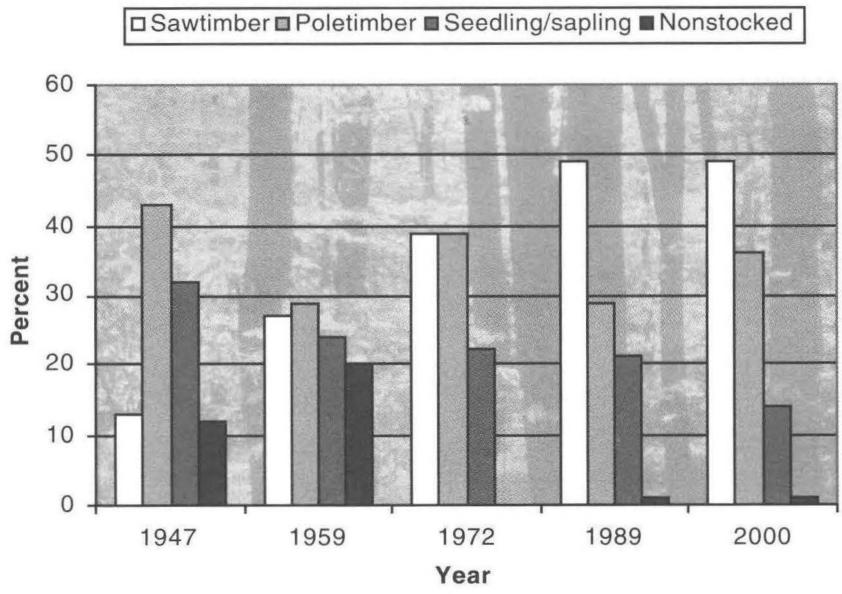

Figure 3. — Area of timberland by stand-size class, Missouri, 1947-2000.

In the hardwood type groups, oak-hickory and oak-gum-cypress forest types have an above average amount of area in the sawtimber-size class. The comparatively low proportion of timberland in sapling-seedling stands for those forest types suggests a relatively low rate of overstory disturbance in those stands. Disturbances that remove the forest overstory occur through natural events such as windstorms or wildfires, or through human activities such as timber harvesting or other management activity. Over the years, increased wildfire suppression has reduced the occurrence of large-scale disturbances that can lead to the establishment of sapling-seedling stands. Without disturbance, oak-hickory stands on mesic sites may convert to other forest types such as maple-basswood. Eastern redcedar has an above average area of timberland in the sapling/seedling class. Changing agricultural practices have idled farmlands and allowed eastern redcedar to expand into those lands (Schmidt and Leatherberry 1995).

Volume

Total net volume of all live trees on forest land in Missouri is 17.7 billion cubic feet, which equates to 1,181 cubic feet per acre of forest land (table 4). Eight of every ten cubic feet of live volume are on privately owned forest land. Ninety-three percent (16.5 billion cubic feet) of net volume of all live trees is contained in hardwoods, and two-thirds is in oak trees. Net volume is computed from a 1-foot stump to a 4-inch top diameter outside bark for live trees at least 5 inches d.b.h.

A measure that has traditionally been used to ascertain wood volume useful for commercial purposes is growing-stock volume on timberland. Growing-stock volume is the amount of solid wood on timberland in commercial trees 5.0 inches d.b.h. and over, from 1 foot above the ground (stump) to a minimum 4-inch top diameter with deductions made for poor form or defect. Growing-stock volume excludes rough, rotten, and dead trees and noncommercial tree species. Missouri's growing-stock volume totals 13.8 billion cubic feet, representing 79 percent of the total live volume (table 5). The remaining 21 percent of volume on timberland is in live cull trees—3.4 billion cubic feet—and in salvable dead trees—258.4 million cubic feet. Cull volume is often used for commercial purposes. For example, in 1997, 94 million cubic feet of non-growing-stock volume were harvested for industrial roundwood products such as for pallets, chips, and even short logs for lumber (Piva *et al.* 2000). Much of that volume was from rough trees. Dead trees are also used for commercial purposes—they are an important source of firewood. Salvable dead trees are also important to wildlife species, such as cavity nesting birds.

Seventy-six percent (10.5 billion cubic feet) of growing-stock volume is in trees in the oak-hickory forest type group (table 6). Growing-stock volume present in the conifer forest type groups accounts for only 3 percent (455 million cubic feet) of Missouri's growing-stock volume. However, growing-stock volume for all conifer trees amounts to 8 percent (1.1 billion cubic feet) of total growing-stock volume because conifers are often found in hardwood stands (table 6).

Approximately two-thirds of all growing-stock volume is in trees that are 11 inches d.b.h.

and larger (table 7). Eight percent of the total growing-stock volume is in trees that are 21 inches d.b.h and larger; most of this volume is oak.

Since the late 1940s, growing-stock volume in Missouri has increased with each succeeding inventory; most of the increase has occurred since 1977 (fig. 4). The increase in growing-stock volume is probably related to the expansion of timberland area and to a forest that is maturing. Further, some of the increase in growing-stock volume may be due to reclassification of former cull timber (non-growing-stock trees, especially rough trees) to growing-stock trees. The probable change in classification is exemplified by the steep drop in cull timber volume between 1989 and 2000, a decline of an estimated 1.4 billion cubic feet. Cull timber volume equaled about half the total for growing-stock volume in 1989, and about a quarter of the total for growing-stock volume in 2000.

Biomass

Biomass in Missouri was estimated at more than 556.5 million dry tons in 2000. This total includes all live aboveground tree biomass in growing-stock trees, non-growing-stock trees, and all live 1- to 5-inch trees (table 9). Seventy percent of the total biomass was in growing-stock trees, 21 percent was in non-growing-stock trees, and the remaining 9 percent was in trees less than 5 inches d.b.h. Ninety-five percent (528 million dry tons) of all live aboveground tree biomass was in hardwood species. Biomass volumes can be useful in assessing fuel loads in forest stands. In Missouri, for example, 88 percent of non-growing-stock biomass is found on private timberland as opposed to public timberlands. This suggests that wildfire protection and suppression activities should be geared more toward private forest landowners.

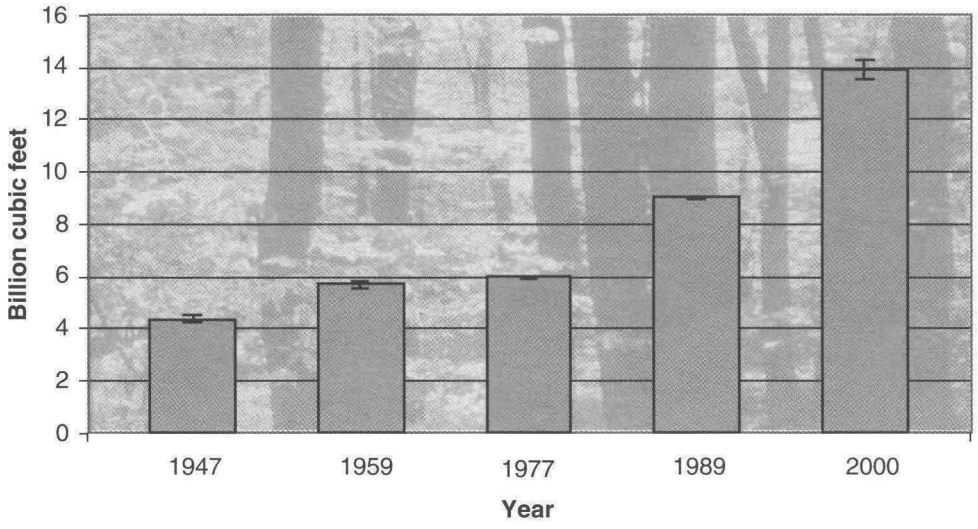

Figure 4. — *Growing-stock volume on timberland, Missouri, 1947-2000. (Note: sampling errors associated with each inventory are represented by the vertical line at the top of each bar.)*

Forest Health

Since the late 1980s, oak decline has been a concern in the Central Hardwood forest (Shriner *et al.* 1986, Kessler 1992). Oak decline is initiated by stress that predisposes trees to attack by secondary pathogens and insects. The Missouri Department of Conservation and the Mark Twain National Forest have detection and monitoring programs in place to track oak decline in the Ozark region. Several pathogens and insects in Missouri are currently affecting the forest. Foliar damage from the jumping oak gall wasp (*Neuroterus saltatorius*) was visible in eastern Missouri for the third consecutive year in 2000. In most cases, damage was not severe. Heavy defoliation by the variable oakleaf caterpillar (*Lochmaeus manteo*) became obvious in south central Missouri in 2000. Variable oakleaf caterpillars feed on a wide range of deciduous trees but prefer oaks, particularly white oak. In 2000, about 40 thousand acres were damaged by variable oakleaf caterpillars in Missouri. Gypsy moth detection is ongoing in Missouri. In 2000, traps in the St. Louis metropolitan area and in Stone County captured 12 moths (fig. 5). In spite of moth captures, there were no known populations of gypsy moths in 2000. However, the risk of gypsy moth establishment in Missouri continues to increase as infested areas in nearby states expand. The information present about pathogens and insects affecting Missouri's forests was obtained from the National Forest Health Monitoring Program (FHM) at: http://www.na.fs.fed.us/spfo/fhm/index.htm. The information presented was for the year 2000. Information covering forest health concerns in Missouri over several years is available at the FHM Web site.

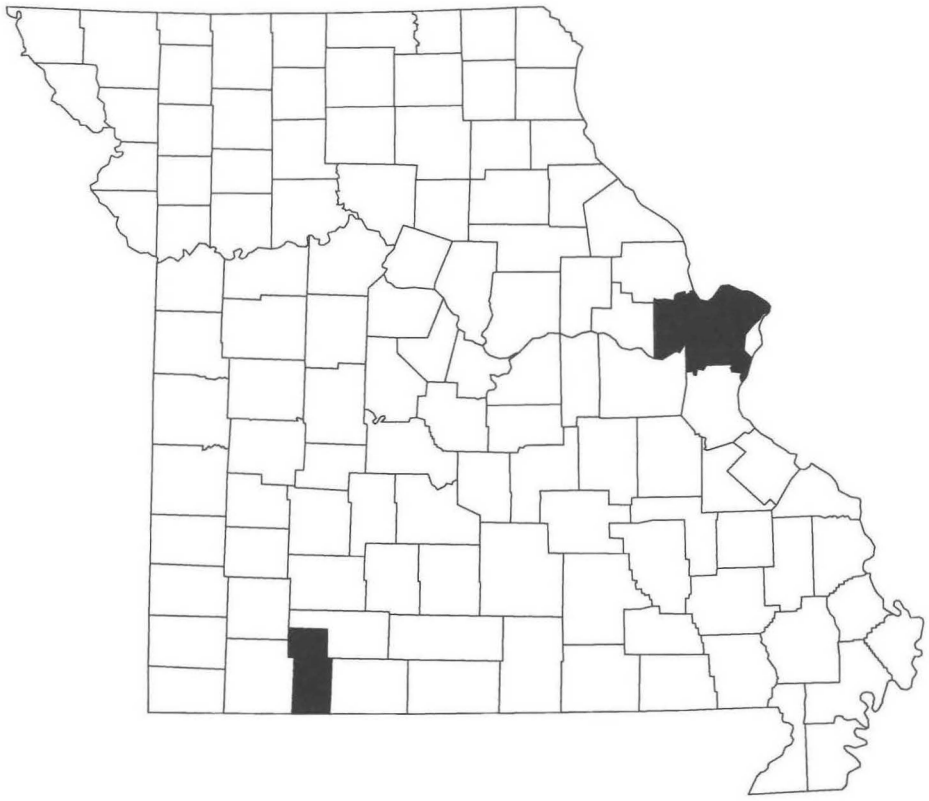

Figure 5. — *Counties in which gypsy moths were detected, Missouri, 2000. (Source: USDA Forest Service, State and Private Forestry Forest Health Protection Program.)*

Summary

In summary, it appears that the forest area in Missouri is steady or increasing. Growing-stock volume has increased by as much as 29 percent since 1989. Missouri's forests appeared healthy in 2000, but, these are preliminary findings. There is continuing strong concern about oak decline. As additional data become available from ensuing annual inventories, a more precise picture of the direction of Missouri's forests will emerge. Additional data related to the two most recent inventories of Missouri (1989 and 2000) are available at: http://www.ncrs.fs.fed.us/4801/fiadb/index.htm

APPENDIX

Inventory Methods

Schmidt (2000) provides a full description of the NCFIA annualized inventory for Missouri. Since the 1989 inventory of Missouri, several changes have been made in NCFIA inventory methods to improve the quality of the inventory as well as meet increasing demands for timely forest resource information. The most significant difference between inventories was the change from periodic inventories to annual inventories. Historically, NCFIA periodically inventoried each State on a cycle that averaged about 12 years. However, the need for timely and consistent data across large geographical regions, combined with national legislative mandates, resulted in NCFIA's implementation of an annual inventory system. Missouri was one of the first States in the North Central region, and one of the first States in the Nation, to be inventoried with this new system, beginning with the 1999 inventory. In addition, the Missouri Department of Conservation contributed personnel and equipment that allowed for intensified sampling in several regions of the State.

With an annual inventory system, about one-fifth of all field plots are measured in any one year. After 5 years, an entire inventory cycle will be completed. After the first 5 years, NCFIA will report and analyze results as a moving 5-year average. For example, NCFIA will be able to generate a report based on inventory results for 1999 through 2004 or for 2001 through 2006. While there are great advantages for an annual inventory, one difficulty is reporting on results in the first 4 years. With the 2000 inventory, only 40 percent of all field plots have been measured. Sampling error estimates for the 2000 inventory results are area of forest land 1.30 percent, area of timberland 1.40 percent, number of growing-stock trees on timberland 2.34 percent, volume of growing stock on timberland 2.25 percent, and

volume of sawtimber on timberland 2.88 percent. These sampling error estimates are considerably higher than those for the last periodic inventory completed in 1989 (i.e., 0.53 percent for timberland area and 1.04 percent for growing-stock volume) because of the smaller sample sizes. Thus, caution should be used when drawing conclusions based on this limited data set. As we complete ensuing measurements, we will have additional confidence in our results due to the increased number of field plots measured. As each measurement year is completed, the precision of estimates will improve.

Other significant changes between inventories include the implementation of new remote sensing technology, implementation of a new field plot design, and gathering of additional remotely sensed and field data. The advent of remote sensing technology since the previous inventory in 1989 has allowed NCFIA to use computer-assisted classifications of Multi-Resolution Land Characterization (MRLC) data and other available remote sensing products to stratify the total area of the State and to improve estimates. Inventories in Missouri before 2000 used manual interpretation of aerial photos to stratify the sample (1969, 1977, and 1989).

New algorithms were used in 2000 to assign forest type and stand-size class to each condition observed on a plot. These algorithms are being used nationwide by FIA to provide consistency among States and will be used to reassign the forest type and stand-size class of every plot measured in the 1989 inventory when it is updated. This will be done so that changes in forest type and stand-size class will more accurately reflect actual changes in the forest and not changes in how values are computed. The list of recognized forest types, grouping of these forest types for reporting purposes, equations used to assign stocking values to individual trees, definition of nonstocked, and names given to the forest types changed with the new algorithms. As a result, comparisons between the published 1989 inventory results and those published for the 2000 inventory may not be valid. For additional details about algorithms used in both inventories, please contact NCFIA.

Sampling Phases

The 2000 Missouri survey used a two-phase sample for stratification that included remeasuring inventory plots from the 1989 inventory and measuring new field plots. Two-phase sampling, also called double sampling, consists of a phase 1 sample used to estimate area by strata and a phase 2 sample used to estimate the average value of parameters of interest within the strata. The estimated population total for a parameter is the sum across all strata of the product of each stratum's estimated area and the parameter's mean per unit area.

The only land that could not be sampled was private land where field personnel could not obtain permission from the owner to measure the field plot and plots that could not be accessed because of a hazard or danger to field personnel. The methods used in the preparation of this report make the necessary adjustments to account for sites where access was denied. Fortunately, there were only 71 denied access plots in 1999 and only 84 denied access plots in 2000.

Phase 1

The 2000 inventory used a computer-assisted classification of satellite imagery for classification. FIA used the imagery to form two initial strata—forest and nonforest. Pixels within 60 m (2 pixel widths) of a forest/nonforest edge formed two additional strata—forest/nonforest and nonforest/forest. Forest pixels within 60 m on the forest side of a forest-nonforest boundary were classified into forest/nonforest strata. Pixels within 60 m of

the boundary on the nonforest side were classified into nonforest/forest strata. An overlay of all national forest land was used to identify all lands owned by the national forests. These national forest lands were treated separately but were also stratified into one of the above four strata. Stratification and estimation were conducted at the State level for national forest lands and at the FIA Inventory Unit level for other lands. In the national forest stratum, forest and forest/nonforest strata were combined.

Phase 2

Phase 2 of the inventory consisted of the measurement of the first annual sample of field plots in Missouri. Current FIA precision standards for annual inventories require a sampling intensity of one plot for approximately every 6,000 acres. FIA has established a grid that divides the entire area of the United States into non-overlapping hexagons, each of which contains approximately 5,937 acres (McRoberts 1999). A grid of field plots was established by selecting one plot from each hexagon based on the following rules: (1) if a Forest Health Monitoring (FHM) plot (Mangold 1998) fell within a hexagon, it was selected as the grid plot; (2) if no FHM plot fell within a hexagon, the existing NCFIA plot from the 1989 inventory nearest the hexagon center was selected as the grid plot; and (3) if neither FHM nor existing NCFIA plots fell within the hexagon, a new NCFIA plot established near the hexagon center was selected as the grid plot (McRoberts 1999). This grid of plots is designated the Federal base sample and is considered an equal probability sample; its measurement in Missouri is funded by the Federal government. The Missouri Department of Conservation funded double intensification of this base sample in several regions of the State. In these regions a second plot was established in each hexagon following the same rules.

The sample of hexagonal grid plots was systematically divided into five interpenetrating, non-overlapping subsamples or panels. Each year the plots in a single panel are measured, and panels are selected on a 5-year, rotating basis (McRoberts 1999). For estimation purposes, the measurement of each panel of plots may be considered an independent random sample of all land in a State. Field crews measured vegetation on plots forested at the time of the last inventory and on plots currently classified as forest by trained photointerpreters using aerial photos or digital ortho-quads.

NCFIA has two categories of field plot measurements—phase 3 plots (FHM plots) and phase 2 field plots—to optimize our ability to collect data when available for measurement. Both types of plot are uniformly distributed both geographically and temporally. Phase 3 plots are measured with the full array of FHM vegetative and health variables collected as well as the full suite of measures associated with phase 2 plots. Phase 3 plots must be measured between June 1 and August 30 to accommodate the measurement of non-woody understory vegetation, ground cover, soils, and other variables. We anticipate that in Missouri the complete 5-year annual inventory will involve about 150 phase 3 plots. On the remaining plots, referred to as phase 2 plots, only variables that can be measured throughout the entire year are collected. In Missouri, the complete 5-year annual inventory is expected to involve about 2,350 phase 2 forested plots. The 1999/2000 annual inventory results represent field measures on 1,408 timberland, 37 other forest land, and 1,989 nonforest plots. The above number of field plots represents a double intensification in the standard base Federal sample in the River Border and Eastern Survey Units of the State and land within the Mark Twain National Forest. This intensification was made possible by additional resources provided by the State of Missouri and the Eastern Region of the USDA Forest Service.

The new national FIA 4-point cluster plot design (fig. 5) was first used for data collection during the 1999 inventory of Missouri. This design was also used in the 2000 inventory and will be used in subsequent years. The national plot design requires mapping forest conditions on each plot. Due to the small sample size (20 percent) each year, precision associated with change factors such as mortality will be relatively low. Consequently, we will not report change estimates until at least three panels have been measured, and even then we anticipate that estimates of change will be limited in detail. When the complete annual inventory has been implemented in 2004, the full range of change variables will be available.

The overall plot layout for the new design consists of four subplots. The centers of subplots 2, 3, and 4 are located 120 feet from the center of subplot 1. The azimuths to subplots 2, 3, and 4 are 0, 120, and 240 degrees, respectively. The center of the new plot is located at the same point as the center of the previous plot if a previous plot existed within the sample unit. Trees with diameter at breast height (d.b.h., or 4.5 feet above ground level) 5 inches and larger are measured on a 24-foot-radius (1/24 acre) circular subplot. All trees less than 5 inches d.b.h. are measured on a 6.8-foot-radius (1/300 acre) circular microplot located at the center of each of the four subplots. Forest conditions that occur on any of the four subplots are recorded. Factors that differentiate forest conditions are changes in forest type, stand-size class, land use, ownership, and density. Each condition that occurs anywhere on any of the subplots is identified, described, and mapped if the area of the condition meets or exceeds 1 acre in size.

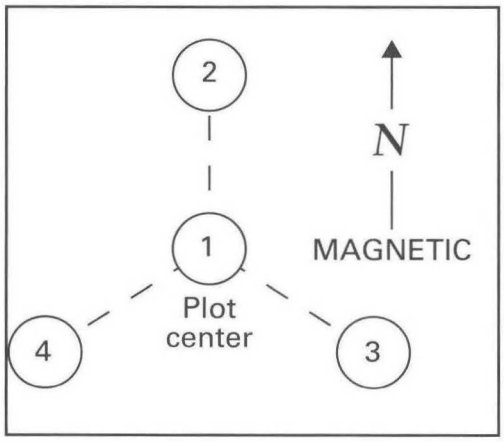

Figure 6. — Current NCFIA field plot design.

Field plot measurements are combined with phase 1 estimates in the compilation process and table production. The number of tables generated from a single year's data is limited. However, as additional annual inventories are completed, the number of tables will increase until year 5, when all statewide inventory summary tables will be available in both printed and electronic formats. For additional information, contact:

Program Manager
Forest Inventory and Analysis
North Central Research Station
1992 Folwell Ave.
St. Paul, MN 55108

Or

State Forester
Missouri Department of Conservation
2901 West Truman Blvd.
P.O. Box 180
Jefferson City, MO 65102

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TABLE TITLES

Table 1.—*Area of forest land by forest type group and owner category, Missouri, 1999-2000*

Table 2.—*Area of timberland by major forest type group, stand origin, and owner category, Missouri, 1999-2000*

Table 3.—*Area of timberland by forest type group and stand-size class, Missouri, 1999-2000*

Table 4.—*Net volume of all live trees on forest land by species group and owner category, Missouri, 1999-2000*

Table 5.—*Net volume of all live trees and salvable dead trees on timberland by class of timber and softwood/hardwood categories, Missouri, 1999-2000*

Table 6.—*Net volume of growing stock on timberland by forest group and softwood/hardwood species categories, Missouri, 1999-2000*

Table 7.—*Net volume of growing stock on timberland by species group and diameter class, Missouri, 1999-2000*

Table 8.—*Net volume of sawtimber on timberland by species group and diameter class, Missouri, 1999-2000*

Table 9.—*All live aboveground tree biomass on timberland by owner category, softwood/hardwood species category, and tree biomass component, Missouri, 1999-2000*

TABLES

Table 1. -- Area of forest land by forest type group and owner category, Missouri, 1999 - 2000

(In thousand acres)

Forest type group	Owner category			
	All owners	Public	Private	Unidentified owner
Softwood type groups				
White / red / jack pine group	4.6	4.6	--	--
Loblolly / shortleaf pine group	135.0	85.0	50.0	--
Pinyon / juniper group	418.5	27.1	391.4	--
All softwood types	558.1	116.6	441.4	--
Hardwood type groups				
Oak / pine group	1,107.4	314.4	792.9	--
Oak / hickory group	10,659.7	1,971.5	8,688.2	--
Oak / gum / cypress group	113.2	9.1	104.0	--
Elm / ash / cottonwood group	1,439.8	152.3	1,287.5	--
Maple / beech / birch group	1,063.4	99.8	963.6	--
All hardwood types	14,383.5	2,547.2	11,836.3	--
Nonstocked	70.4	7.9	62.6	--
All forest types	15,012.0	2,671.7	12,340.3	--

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their total due to rounding.

Table 2. -- Area of timberland by major forest type group, stand origin, and owner category, Missouri, 1999 - 2000

(In thousand acres)

Major forest type group and stand origin	Owner category			
	All owners	Public	Private	Unidentified owner
Softwood type groups				
Natural	487.9	63.7	424.2	--
Planted	51.0	42.6	8.4	--
All softwood types	538.9	106.3	432.6	--
Hardwood type groups				
Natural	13,978.2	2,289.7	11,688.4	--
Planted	27.9	11.6	16.2	--
All hardwood types	14,006.0	2,301.3	11,704.7	--
Nonstocked	70.4	7.9	62.6	--
All groups	14,615.4	2,415.5	12,199.8	--

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 3. -- Area of timberland by forest type group and stand-size class, Missouri, 1999 - 2000

(In thousand acres)

Forest type group	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling-seedling	Non-stocked
Softwood type groups					
White / red / jack pine group	4.6	4.6	--	--	--
Loblolly / shortleaf pine group	135.0	86.4	48.6	--	--
Pinyon / juniper group	399.4	74.2	187.5	137.7	--
All softwood types	538.9	165.1	236.1	137.7	--
Hardwood type groups					
Oak / pine group	1,073.6	357.9	410.3	305.5	--
Oak / hickory group	10,384.2	5,542.2	3,890.8	951.2	--
Oak / gum / cypress group	113.2	78.5	22.6	12.1	--
Elm / ash / cottonwood group	1,382.4	659.0	394.1	329.2	--
Maple / beech / birch group	1,052.7	398.4	318.4	335.8	--
All hardwood types	14,006.0	7,036.0	5,036.1	1,933.9	--
Nonstocked	70.4	--	--	--	70.4
All forest types	14,615.4	7,201.1	5,272.2	2,071.6	70.4

All table cells without observations in the inventory sample are indicated by --. Table value of 0.0 indicates the acres round to less than 0.1 thousand acres. Columns and rows may not add to their totals due to rounding.

Table 4. -- Net volume of all live trees on forest land by species group and owner category, Missouri, 1999 - 2000

(In thousand cubic feet)

Species group	Owner category			
	All owners	Public	Private	Unidentified owner
Softwoods				
Loblolly and shortleaf pines	773,426	454,263	319,163	--
Eastern white and red pines	11,331	11,331	--	--
Cypress	743	--	743	--
Other eastern softwoods	497,067	47,521	449,546	--
Total softwoods	1,282,567	513,115	769,451	--
Hardwoods				
Select white oaks	4,197,712	900,505	3,297,206	--
Select red oaks	1,011,149	175,250	835,899	--
Other white oaks	1,765,135	215,470	1,549,664	--
Other red oaks	4,169,743	963,082	3,206,661	--
Hickory	1,525,349	275,893	1,249,456	--
Hard maple	215,870	32,987	182,883	--
Soft maple	375,556	82,171	293,385	--
Beech	19,095	14,116	4,978	--
Sweetgum	51,602	11,668	39,934	--
Tupelo and blackgum	89,228	29,743	59,485	--
Ash	367,788	19,393	348,395	--
Cottonwood and aspen	213,756	53,205	160,552	--
Basswood	41,047	5,120	35,926	--
Yellow-poplar	10,918	173	10,745	--
Black walnut	447,114	52,634	394,479	--
Other eastern soft hardwoods	1,372,687	165,972	1,206,715	--
Other eastern hard hardwoods	439,930	29,885	410,045	--
Eastern noncommercial hardwoods	134,814	4,640	130,174	--
Total hardwoods	16,448,491	3,031,909	13,416,582	--
All species groups	17,731,058	3,545,025	14,186,033	--

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

Table 5. -- Net volume of all live trees and salvable dead trees on timberland by class of timber and softwood/hardwood categories, Missouri, 1999 - 2000

(In thousand cubic feet)

Class of timber	All species	Softwood species	Hardwood species
Live trees			
Growing-stock trees			
Sawtimber			
Saw log portion	7,679,318	649,600	7,029,719
Upper stem portion	1,426,343	85,296	1,341,048
Total	9,105,662	734,895	8,370,766
Poletimber	4,724,512	389,818	4,334,694
All growing-stock trees	13,830,174	1,124,713	12,705,461
Cull trees			
Rough trees [1]			
Sawtimber size	2,012,221	83,826	1,928,396
Poletimber size	983,041	54,519	928,522
Total	2,995,263	138,345	2,856,918
Rotten trees [1]			
Sawtimber size	400,525	- -	400,525
Poletimber size	36,366	549	35,817
Total	436,891	549	436,342
All live cull trees	3,432,153	138,894	3,293,259
All live trees	17,262,327	1,263,607	15,998,720
Salvable dead trees			
Sawtimber size	140,506	6,471	134,035
Poletimber size	117,929	5,357	112,573
All salvable dead trees	258,436	11,828	246,608
All classes	17,520,763	1,275,435	16,245,328

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

[1] Includes noncommercial species.

Table 6. -- Net volume of growing stock on timberland by forest group and softwood/hardwood species categories, Missouri, 1999 - 2000

(In thousand cubic feet)

Forest type group	All species	Softwood species	Hardwood species
Softwood type groups			
White / red / jack pine group	10,012	9,437	575
Loblolly / shortleaf pine group	266,202	226,219	39,983
Pinyon / juniper group	178,710	123,067	55,643
All softwood types	454,924	358,723	96,201
Hardwood type groups			
Oak / pine group	816,583	419,404	397,180
Oak / hickory group	10,528,773	324,959	10,203,814
Oak / gum / cypress group	196,789	- -	196,789
Elm / ash / cottonwood group	1,207,608	1,947	1,205,662
Maple / beech / birch group	624,876	19,419	605,457
All hardwood types	13,374,629	765,729	12,608,901
Nonstocked	621	261	359
All forest types	13,830,174	1,124,713	12,705,461

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

Table 7. -- Net volume of growing stock on timberland by species group and diameter class, Missouri, 1999 - 2000

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods											
Loblolly and shortleaf pines	765,721	59,215	111,883	158,893	160,552	115,205	84,634	46,488	28,852	--	--
Eastern white and red pines	9,239	--	858	1,148	2,518	4,714	--	--	--	--	--
Cypress	743	--	--	--	743	--	--	--	--	--	--
Other eastern softwoods	349,011	119,454	98,408	77,174	31,524	16,729	4,005	1,717	--	--	--
Total softwoods	1,124,713	178,669	211,149	237,215	195,337	136,648	88,639	48,205	28,852	--	--
Hardwoods											
Select white oaks	3,424,422	231,568	352,165	493,362	578,847	554,931	457,386	344,944	180,329	230,890	--
Select red oaks	810,942	36,780	61,753	76,226	87,860	114,958	107,079	99,289	90,974	136,021	--
Other white oaks	1,286,301	140,000	227,846	253,374	225,696	197,088	126,460	60,192	37,064	18,581	--
Other red oaks	3,490,456	209,617	312,826	493,137	620,552	581,147	476,044	312,451	186,286	249,668	48,729
Hickory	1,261,464	177,657	232,726	219,730	224,101	154,501	102,829	47,821	30,185	71,914	--
Hard maple	158,625	29,849	24,990	28,044	24,915	9,141	8,734	12,990	11,180	8,782	--
Soft maple	205,534	9,324	13,252	12,548	18,723	21,457	32,380	23,529	21,437	52,884	--
Beech	739	--	277	462	--	--	--	--	--	--	--
Sweetgum	44,085	2,027	3,354	4,334	4,934	5,442	9,531	10,999	3,464	--	--
Tupelo and blackgum	74,877	11,621	13,434	13,761	9,742	9,048	5,356	3,236	4,189	4,489	--
Ash	254,764	21,266	35,145	36,171	40,346	39,967	34,747	14,805	8,368	23,949	--
Cottonwood and aspen	198,737	2,195	638	2,654	3,974	1,627	15,586	11,055	11,674	34,207	115,129
Basswood	27,311	738	2,847	4,754	1,990	2,194	--	3,804	4,909	6,074	--
Yellow-poplar	10,745	395	--	825	2,554	3,227	--	--	3,743	--	--
Black walnut	327,660	17,899	31,696	42,343	58,707	43,153	42,666	38,129	34,235	18,831	--
Other eastern soft hardwoods	921,896	118,754	126,310	119,065	124,460	107,617	79,458	105,635	50,064	75,622	14,912
Other eastern hard hardwoods	206,903	24,970	32,368	27,616	27,451	29,603	10,077	15,723	29,338	9,757	--
Total hardwoods	12,705,461	1,034,660	1,471,629	1,828,405	2,054,853	1,875,101	1,508,333	1,104,601	707,438	941,670	178,770
All species	13,830,174	1,213,329	1,682,777	2,065,621	2,250,190	2,011,749	1,596,972	1,152,806	736,290	941,670	178,770

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand cubic feet. Columns and rows may not add to their totals due to rounding.

Table 8. -- Net volume of sawtimber on timberland by species group and diameter class, Missouri, 1999 - 2000

(In thousand board feet) [1]

Species group	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Loblolly and shortleaf pines	3,076,371	792,439	823,222	602,335	450,456	251,785	156,135	--	--
Eastern white and red pines	40,041	5,334	11,951	22,757	--	--	--	--	--
Cypress	3,079	--	3,079	--	--	--	--	--	--
Other eastern softwoods	698,193	427,870	162,816	81,317	18,549	7,639	--	--	--
Total softwoods	3,817,685	1,225,642	1,001,068	706,410	469,005	259,425	156,135	--	--
Hardwoods									
Select white oaks	11,064,549	--	2,827,073	2,663,903	2,158,927	1,595,435	816,957	1,002,253	--
Select red oaks	3,152,332	--	435,881	574,534	536,625	496,216	451,477	657,599	--
Other white oaks	3,214,805	--	1,100,492	957,887	611,517	284,356	177,250	83,304	--
Other red oaks	12,159,238	--	3,079,405	2,893,815	2,365,069	1,541,721	907,150	1,178,610	193,467
Hickory	3,090,582	--	1,097,054	756,413	503,862	234,162	148,091	351,000	--
Hard maple	357,546	--	118,699	43,494	41,615	61,370	52,078	40,290	--
Soft maple	737,289	--	81,261	94,024	142,249	103,276	93,651	222,828	--
Beech	--	--	--	--	--	--	--	--	--
Sweetgum	155,618	--	22,471	24,965	43,363	49,348	15,470	--	--
Tupelo and blackgum	164,720	--	45,212	41,523	24,774	14,811	18,624	19,775	--
Ash	755,659	--	182,717	184,974	163,561	70,451	39,877	114,079	--
Cottonwood and aspen	908,837	--	19,116	8,136	78,049	54,686	59,633	176,602	512,616
Basswood	93,615	--	10,075	11,044	--	18,900	24,119	29,476	--
Yellow-poplar	47,246	--	12,407	15,104	--	--	19,735	--	--
Black walnut	1,108,232	--	279,991	205,459	201,633	179,894	158,207	83,047	--
Other eastern soft hardwoods	2,535,789	--	568,449	489,951	360,284	479,635	228,436	343,576	65,457
Other eastern hard hardwoods	554,767	--	126,483	136,495	45,906	71,045	131,803	43,034	--
Total hardwoods	40,100,822	--	10,006,786	9,101,720	7,277,434	5,255,307	3,342,560	4,345,473	771,541
All species	43,918,507	1,225,642	11,007,854	9,808,130	7,746,439	5,514,732	3,498,695	4,345,473	771,541

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates that the volume rounds to less than 1 thousand board feet. Columns and rows may not add to their totals due to rounding.

[1] International 1/4-inch rule.

Table 9. -- All live aboveground tree biomass on timberland by owner category, softwood/hardwood species category, and tree biomass component, Missouri, 1999 - 2000

(In dry tons)

Owner category and softwood/hardwood category	All components	Tree biomass component						
		All live 1-5 inch trees	Growing-stock trees			Non-growing-stock trees		
			Total	Boles	Stumps, tops, and limbs	Total	Boles	Stumps, tops, and limbs
Public								
Softwoods	10,427,995	816,627	9,329,534	7,774,443	1,555,091	281,835	211,462	70,373
Hardwoods	89,814,830	9,249,316	66,225,971	47,381,301	18,844,669	14,339,544	10,422,552	3,916,991
Total	100,242,826	10,065,943	75,555,504	55,155,744	20,399,760	14,621,378	10,634,014	3,987,364
Private								
Softwoods	19,999,187	3,949,218	13,046,659	9,951,769	3,094,890	3,003,310	2,143,354	859,957
Hardwoods	436,264,226	36,388,625	298,875,061	213,228,981	85,646,079	101,000,540	73,321,903	27,678,637
Total	456,263,413	40,337,843	311,921,720	223,180,750	88,740,969	104,003,850	75,465,257	28,538,593
All ownerships								
Softwoods	30,427,182	4,765,845	22,376,192	17,726,212	4,649,980	3,285,145	2,354,816	930,329
Hardwoods	526,079,056	45,637,941	365,101,031	260,610,283	104,490,749	115,340,084	83,744,455	31,595,628
Total	556,506,239	50,403,787	387,477,224	278,336,495	109,140,729	118,625,228	86,099,271	32,525,957

All table cells without observations in the inventory sample are indicated by --. Table value of 0 indicates the aboveground tree biomass rounds to less than 1 dry ton. Columns and rows may not add to their totals due to rounding.

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Leatherberry, Earl C.; Treiman, Thomas B.

2002. **Missouri's forest resources in 2000.** Resour. Bull. NC-209. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 23 p.

Results of the fifth annual inventory of Missouri show that since 1989 forest land area has increased slightly. The forest is composed predominantly of hardwoods—the oak-hickory forest type alone occupies 71 percent of the timberland area. Softwood occupies 4 percent of timberland area, and the area of eastern redcedar is expanding. Between 1989 and 2000, total volume of all live trees on timberland increased by 25 percent, from 13.8 billion cubic feet to 17.3 billion cubic feet. Oak decline is a continuing concern, along with the risk of gypsy moth establishment in Missouri.

KEY WORDS: Annual inventory, forest area, forest type, volume, biomass, Missouri